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(56) Documents Cited
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US 4803941 A US 4800392 A

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(54) Abstract Title
Directive antenna for mobile telephones

(57) A patch antenna for use with folding mobile telephones comprises conjoined larger 1 and smaller 3 patches to provide operation of the telephone in two separate frequency bands. Both larger and smaller patches may be formed from a single metal sheet and held in parallel spaced relationship by an intermediate portion 2. The antenna may also be fabricated by the deposition of a metallic film on an insulating plate and can be concealed within the telephone. A reflective ground plane 6 is formed as part of the telephone housing.

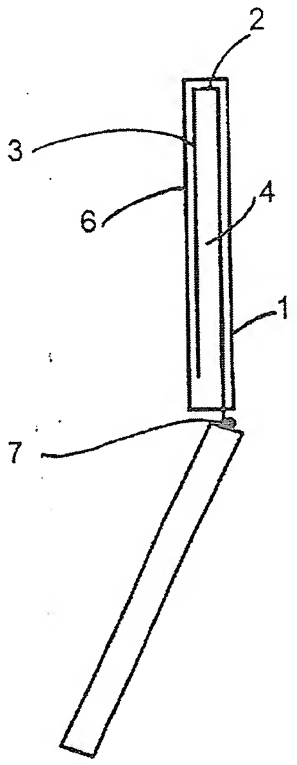

Figure 4

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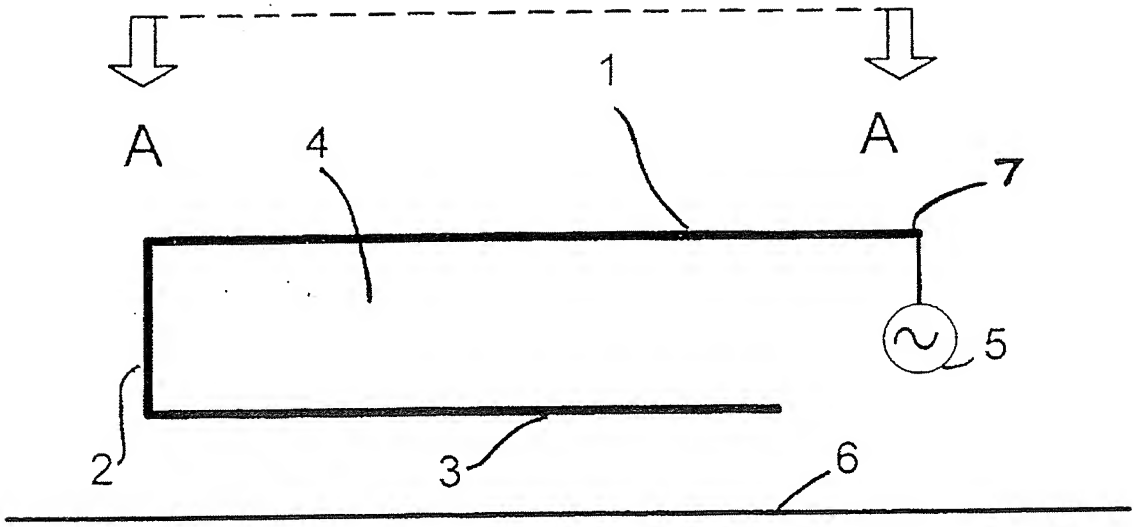
Figure 1



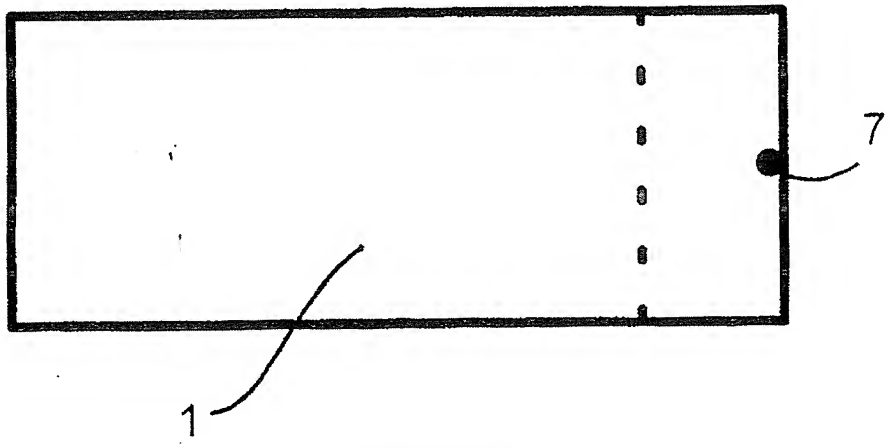


Figure 2

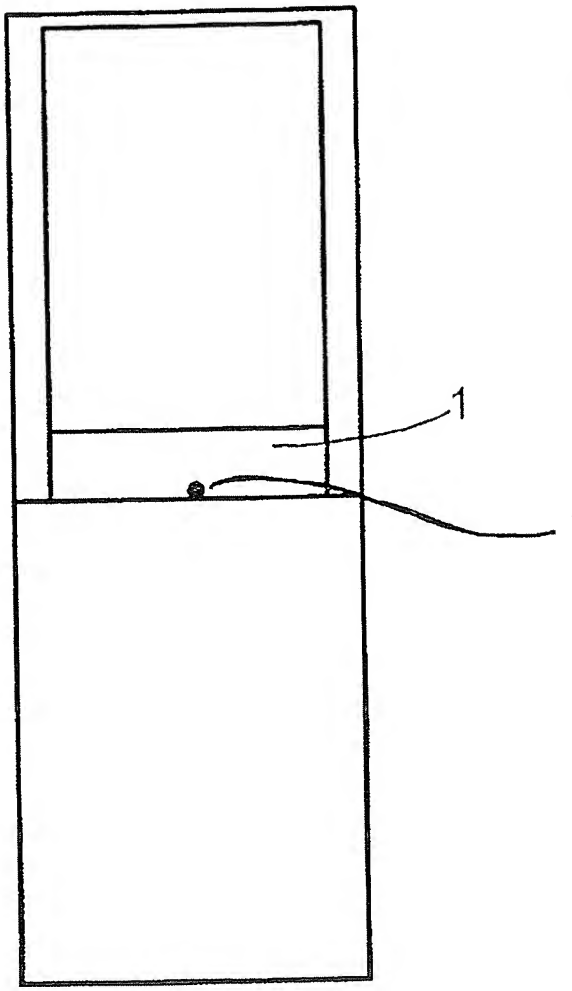


Figure 3

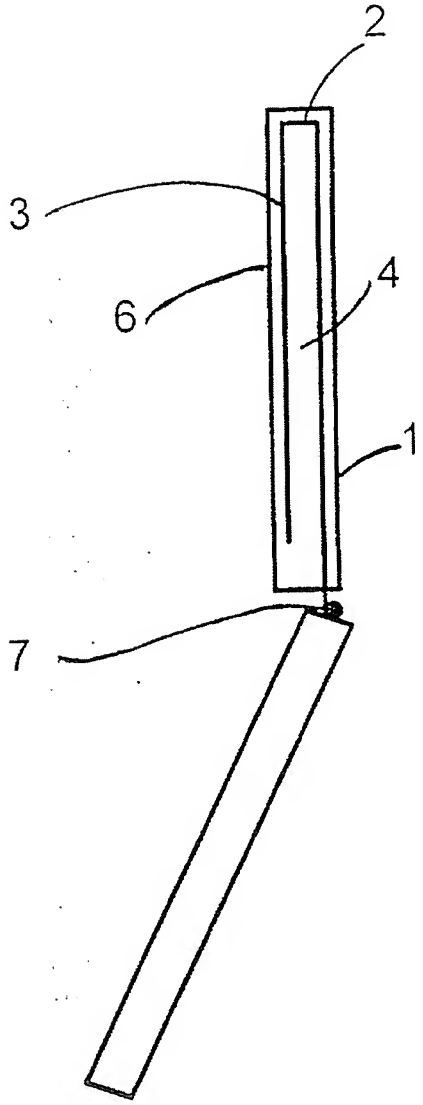


Figure 4

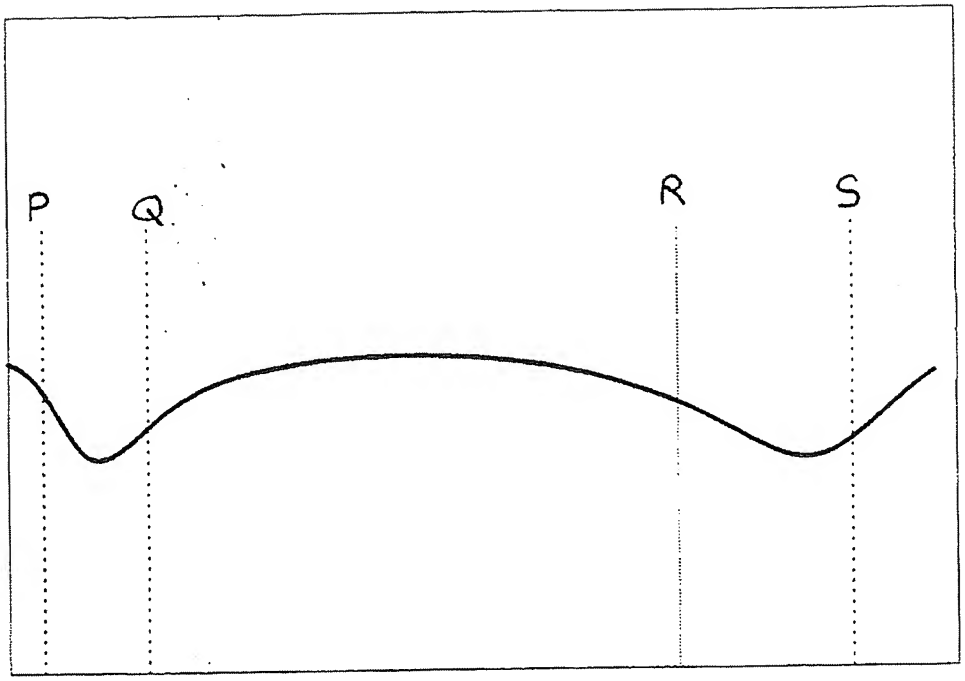


Figure 5

Directive antenna for mobile telephones

This invention relates to antennas for use with radio transceivers and in particular for use with mobile telephones.

The design of antennas for radio transmitter/receivers (transceivers) capable of operation in more than one frequency band is constrained by the market demand continually to reduce the overall size of radio transceivers. The term "dual mode" is generally used to describe a radio transceiver capable of operation in two separate frequency bands and that description will be used herein.

An antenna for a foldable or "flip" telephone will need to be especially compact while still being capable of providing satisfactory performance. Simplified illustrations of a foldable phone are given in the accompanying figures. Foldable phones as illustrated in the figures usually comprise two housings of approximately the same size.

When such a telephone is in the closed position, performance of the antenna must also be sufficient to enable the satisfactory reception of incoming signals. The two sections of the flip phone are usually connected by a hinge mechanism and the phone is normally used in the open position as shown in figure . Incoming calls however, as well as text and data messages must be received when the phone is in the closed position with the two sections of the phone pushed together.

The display screen and keypad would usually be located in the bottom section of the phone.

The performance of many prior art antennas is significantly reduced by the proximity of the user during operation of the phone. It has been observed, however, that for antennas constructed in accordance with the invention only a small degradation occurs (less than 1dB).

It is an object of the invention to provide a compact dual mode duplex antenna which is simple to manufacture. A further object of the invention is to construct a dual mode duplex antenna which transmits, when in operation, only very low power levels of RF (radio frequency) towards the body of the user.

According to the invention there is provided for use with a mobile telephone, a patch antenna for transmission and reception of RF in two frequency bands said antenna comprising a single metal sheet formed to provide a larger patch and a smaller patch with part of the metal sheet intermediate and contiguous with larger and smaller patches, the larger and smaller patches being maintained in parallel spaced relationship with each other above a reflecting ground plane.

The single metal sheet may also be formed by the deposition of the metal on an insulating plate.

One example of the invention will now be described with reference to the accompanying figures.

Figure 1 is a simplified cross sectional view of an antenna constructed in accordance with the invention.

Figure 2 is a plan view of the antenna in the direction A-A of figure 1.

Figure 3 is a simplified view of a foldable phone in the open position.

Figure 4 is a simplified side view of a foldable phone in the open position.

Figure 5 is a plot of antenna gain versus frequency for the folded patch antenna.

In this example, a foldable telephone as illustrated in figs 2 and 3 is operable in two network bands, the two network bands being GSM 900 operating in the band 890 to 960 MHz and DCS 1800 operating in the band 1710 to 1880 MHz.

With reference to the figures, in which the parts illustrated are given the same numbers throughout, a simplified cross sectional view of the antenna is shown in figures 1 and 2. The antenna comprises a single rectangular sheet of copper which has been bent firstly to produce a first patch antenna section 1 and secondly to produce a second patch antenna section 3, sections 1 and 3 being joined by and contiguous with section 2. Section 2 is

an integral part of the copper sheet and maintains the two sections 1 and 3 in substantially parallel spaced relationship with each other. An air gap 4 exists between sections 1 and 3. Other low absorption insulators may be used in place of air gap 4 and may be selected from a range of such insulators well known in the art. The antenna is backed by a ground plane 6 and is fed by means of a coaxial connector 5 to the distal edge of the larger patch at 7 where excitation of the antenna is effected.

The reflecting grounded plane 6 may be provided, as in this example, as part of the housing of the phone. The larger antenna section 1 operates in duplex mode in the frequency band 890 to 960 MHz (GSM 900) and the smaller antenna section 3 operates in the duplex mode in frequency band 1710 to 1880 MHz (DCS 1800).

Use of the antenna with a foldable phone is illustrated in figures 3 and 4. The antenna is contained within the top section of the phone and the ground plane is part of the case of the phone. The resonance frequencies of the antenna are determined by the lengths of the larger and smaller patches. The bandwidth of operation is affected by the distance of the antenna from the reflecting ground plate 6, the type of dielectric material 4 , the width of the larger and smaller patches 1, 3 and the width of the reflecting plate 6.

The plot of antenna gain versus frequency at figure 5 shows the results achieved by the antenna in the two frequency bands DCS 1800 and GSM 900. With reference to 0dB the point P on the plot is 890 MHz and -11.483

dB, the point **Q** is 960 MHz and -11.156 dB, the point **R** is 1.72 GHz and -8.989 dB and the point **S** is 1.88 GHz and -12.573 dB.

Claims

1. For use with a mobile telephone, a patch antenna for transmission and reception of RF in two frequency bands said antenna comprising a single metal sheet formed to provide a larger patch and a smaller patch with part of the metal sheet intermediate and contiguous with larger and smaller patches, the larger and smaller patches being maintained in parallel spaced relationship with each other above a reflecting ground plane.

2. An antenna as in claim 1 where the parallel spaced relationship between larger and smaller patches is maintained by means of said part of the metal sheet intermediate and contiguous with larger and smaller patches.

3. An antenna as in claims 1 or 2 where electrically insulating material occupies the space between larger and smaller patches.

4. An antenna as in claim 3 where the electrically insulating material between larger and smaller patches is an air gap.

5. An antenna as in claim 1 where the metal sheet is formed by plating on an insulated board.

6. An antenna as in any of the above claims where both larger and smaller patches have the same width.

7. An antenna as in any of the above claims where the reflecting grounded plane is part of the housing of the phone.

8. An antenna as in any of the above claims where the antenna is fed at the distal edge of the larger patch.

9. An antenna as in any of the above claims for use in the two frequency bands 890 to 960 MHz and 1710 to 1880 MHz.

The Patent Office

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Claims searched: 1 to 9

Examiner: J L Freeman
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H1Q (QJC, QKA)

Int Cl (Ed.6): H01Q (1/24, 1/27)

Other: On-line: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2240219 A	(NEC Corporation) Figure 5	1 to 4, 6 & 8
X	WO 94/24722 A1	(Wireless Access) Figures 1 to 3	1 to 4 & 6
X	US 5644319	(Y J Chen *et al*) Figures 2 to 5	1 to 4
X	US 4803491	(H Hikuma) Figures 3A to D	1
X	US 4800392	(O M Garay *et al*) Figure 6	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.